Fluidic Fuel Flow Modulation for Active Combustion Control, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

We propose a novel method of high frequency, high control authority fluidic modulation of pilot fuel flow to enable implementation of active combustion instability control (ACIC) either by feedback control or decoupling of the heat release frequency with that of the resonance frequency of the combustion chamber. The possible rugged design of the fluidic device permits its installation in the harsh environment right upstream of the fuel injector thus enabling closer coupling for high-fidelity control action. The method also provides a means of accurate measurement of fuel flow metered through the device. In Phase I, we propose design, fabrication and testing of two fluidic methods of pulsing the fuel one method is driven by a fluidic oscillator and a second method by a vortex diode using an externally triggered pulse for phase controlled pulsations. In Phase II, based on the obtained performance characteristics and the customer needs, we will down-select the best of the options for further development.

ANTICIPATED BENEFITS

To NASA funded missions:

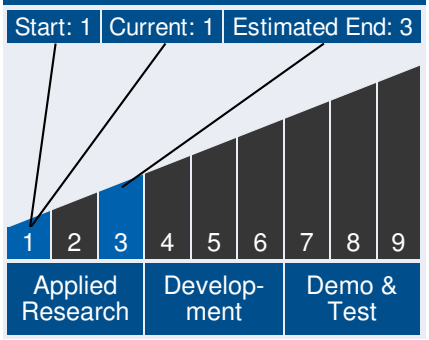
Potential NASA Commercial Applications: The fluidic fuel flow modulator developed in this project will enable NASA GRC to evaluate the device in its specially designed characterization test rig for suitability in using it for active combustion instability control. The device will also help in the development of suitable control algorithms by NASA for implementation in actual jet engines. The fuel flow modulator can also be used to mitigate combustion instabilities in liquid fuel rockets as well - thus making the technology available for space launch vehicle design.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The market need for fuel modulators for active control of combustion instability in lean-burn combustors runs in millions both for aircraft engines

Table of Contents

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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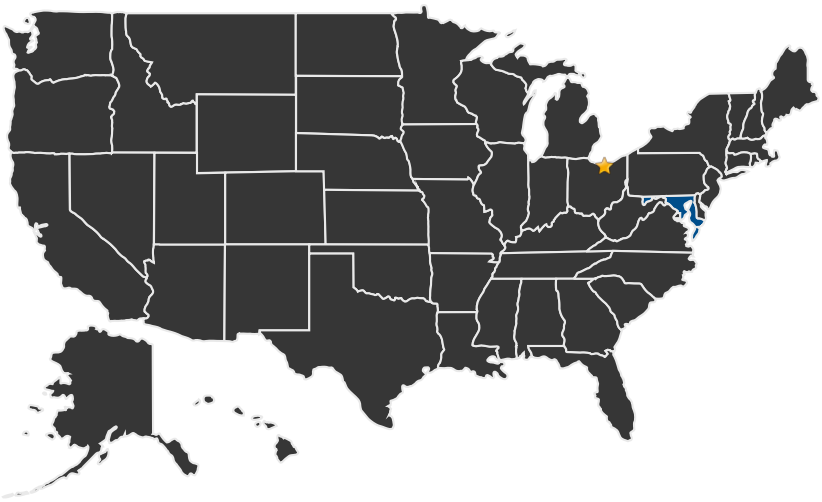
as well as land-based gas turbines for power generation. In addition, there is a demand for such modulators for active control of reheat buzz in the military airplanes with afterburners. Potential end-customers are: Pratt & Whitney General Electric Siemens Rolls Royce

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

- Advanced Fluidics, LLC (Ellicott City, MD)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23526)

Management Team *(cont.)*

Principal Investigator:

- Surya Raghu

Technology Areas

Primary Technology Area:
Launch Propulsion Systems (TA 1)
└ Air Breathing Propulsion Systems (TA 1.3)
  └ Turbine-Based Jet Engines (TA 1.3.4)

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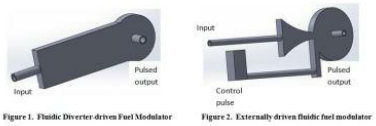
IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

Fluidic Fuel Flow Modulation for Active Combustion Control, Phase I

Potential Applications

The fluidic fuel flow modulator developed in this project will enable NASA GRC to evaluate the device in its specially designed characterization test rig for suitability in using it for active combustion instability control. The device will also help in the development of suitable control algorithms by NASA for implementation in actual jet engines. The fuel flow modulator can also be used to mitigate combustion instabilities in liquid fuel rockets as well - thus making the technology available for space launch vehicle design.